



Introduction

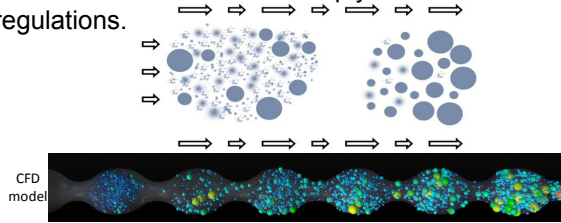
The nano-size particles weight is only 1-20% of the total particle mass while their number may be more than 90%. Due to their small size, their residence time in the air is much longer and so is the human exposure to these harmful particles.

Over the last years a number of attempts have been made to suppress the formation rate of particles inside the cylinder and to reduce the emitted particles mass with after-treatment devices.

The new EURO-6 regulations requires for the first time to reduce PN.

Grouping Phenomenon

Small particles, in the nano scale range, have higher tendency to move as **groups** and cluster in an oscillating flow. In such conditions, particles may coagulate and increase their size, reduce the total particle number and comply with new EURO-6 regulations.



Experiments- GDI engine-NEDC COLD

Citroen C5 light-duty, 4-cylinder, GDI, 1600cc car equipped with a gasoline engine on a suitable roller test bench running the regulated standard driving cycle NEDC Cold with Grouping pipe and without between 2 mufflers.

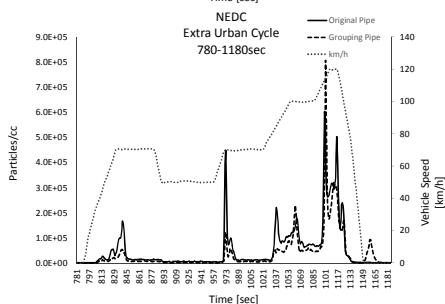
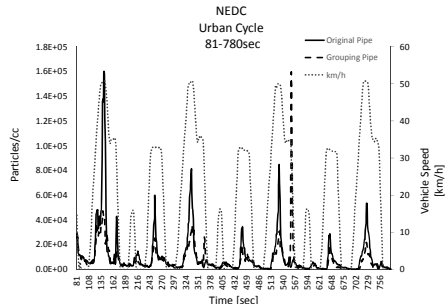
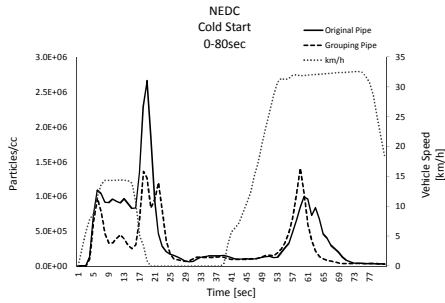
An average of 3 days with Grouping pipe and 4 days with Original pipe. Measurements taken after CVS with CPC device.



Original Pipe **Grouping Pipe**

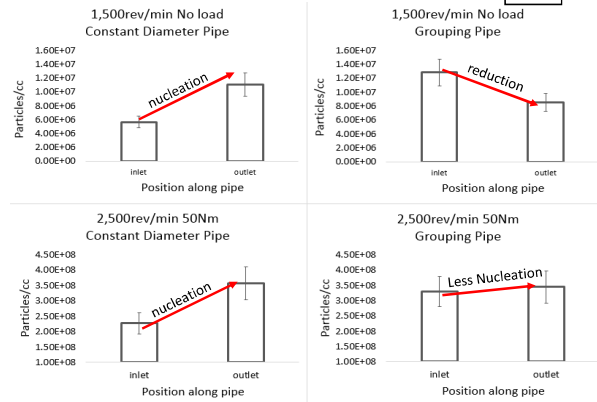
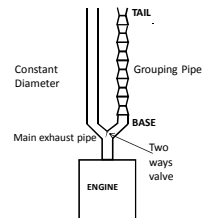
6.4·10¹¹Particles/km **5.3·10¹¹Particles/km**

Particles number as collected at tailpipe with PPS:



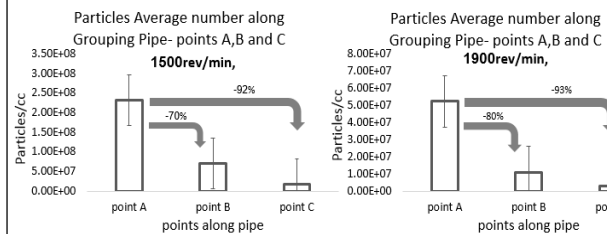
Experiments- Diesel engine on bench

Ford Diesel engine, 4-cylinder, 2000cc on a test bench. PN measurements were collected using Pegasor Particle Sensor (PPS) The PPS provides real-time data of the total number of particles in the range of 10nm to 2.4µm



Experiment-Diesel engine on EURO-4 bus

The original exhaust pipe section between the catalytic converter and the DPF was replaced by a grouping-pipe. Measurements taken after catalytic converter(A), at the DPF entrance (B) and at the DPF exit (C).



Tailpipe emissions sampled 10cm from the exhaust edge, X100,000 magnification.

